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Group Art Unit: 2826

REMARKS

Allowable Subject Matter

In the Office Action mailed February 25, 2005, the Examiner indicated that claims 8 and 9 would be allowable if rewritten to overcome the rejection(s) set forth below under 35 U.S.C. 112, 1st paragraph, and to include all of the limitations of the base claim and any intervening claims.

Regarding claims 8 and 9, Applicants appreciate this indication of allowable subject matter. It is believed that the clarifying amendments to claims 8 and 9 now render independent claim 7 allowable as further explained below.

Claims 15 and 16 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form, including all of the limitations of the base claim and any intervening claims.

Regarding claims 15 and 16, Applicants appreciate this indication of allowable subject matter. It is believed that the clarifying amendments to claims 15 and 16 now render claim 14 allowable as further explained below.

Drawings

The Examiner stated the drawings are objected to under 37 CFR 1.83(a) because the drawings must show every feature of the invention specified in the claims.

"Therefore, the first conformal barrier layer having only vertical portions according to claim 14, a treated area on the first channel stop layer according to claim 14;...must be shown or the feature(s) canceled from the claim(s). No new matter should be entered."

Regarding the specified features according to claim 14, it is respectfully submitted that, without being limiting, the first conformal barrier layer 146 having only vertical portions is shown in FIG. 5. Similarly, it is respectfully submitted that, without being limiting, a treated area 150 is on the first conformal barrier liner 146, and the first channel stop layer 120 is shown in FIG. 6. The latter is explained in the Specification page 9, lines 22-27:

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"In the present invention, it has been discovered that that the silane treatment for providing silicon-enriched surfaces 150 and/or the deposition of the wetting layer 152 will provide acceptable surfaces for seed layer deposition. Either or both the silicon-enrichment and wetting layer treatments appear to increase adhesion of the seed layer 134 to the remaining liner portions 146, the second via stop layer 124, the stepped region 148, the remaining portions of the conformal barrier liner 146, and the first channel 102 over the adhesion without such treatments."

The Examiner continues:

" a first conductor core over the first channel stop layer; and the first conformal barrier layer having only vertical portions of a constant thickness according to amended claim 7 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered."

It is respectfully submitted that the claimed first conductor core is:

"a first conductor core in the opening over the vertical portions of the first conformal barrier liner and the first stop layer,"

Regarding the specified feature according to amended claim 7, it is respectfully submitted that, without being limiting, the first conductor core 136 in the opening over the vertical portions of the first conformal barrier liner 146 and the first stop layer 120 is shown in FIGs. 5 and 9.

The Examiner continues:

"As shown in figure 2, the first conformal barrier liner 126 does not have only vertical portion and does not have a constant thickness. The treated area 128 is not formed on the first channel stop layer 114. In other words, the drawings do not show that the first channel stop layer 114 having [sic] a treated area. The first conformal barrier liner of claims 7/14 correspond [sic] to the conformal barrier layer 126 described in the specification and shown in the drawings since this is the liner formed on the first dielectric layer/first channel dielectric layer 108."

Regarding the specified features as shown in FIG. 2, it is respectfully submitted that the Specification does not disclose element 126 to be a conformal barrier liner (146) but describes it as a barrier layer 126. As a result of this misidentification, it is respectfully submitted that the remainder of the Examiner's statement will also be found to be incorrect.

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The Examiner continues:

"Also, the layer 112 correspond [sic] to the claimed via dielectric layer of claims 8/15; the layer 110 correspond [sic] to the second dielectric layer/second channel dielectric layer of claims 8/15. (see pg. 6/lis. 17-32; pg. 7/lis. 1-29).

Regarding the specified features according to claims 8 and 15, it is respectfully submitted that the misidentification of element 126 has resulted in the above statement being incorrect.

The Examiner continues:

In the event that applicant read the first dielectric layer/first channel dielectric layer as to correspond [sic] to the layer 112 (described in the specification as to be via dielectric layer) and the first conformal barrier liner correspond [sic] to the 146, it is respectfully noted that the via stop layer and the via dielectric layer according to claim 8 and 15 are not shown. Note the layer 110 is the second dielectric layer and cannot be recognized as the via dielectric layer."

Applicants appreciate the Examiner pointing out the above and have amended claims 8, 9, 15, and 16 to correct the incorrect nomenclature identified by the Examiner. No new matter has been added.

Claim Rejections - 35 USC §112

Claim 7 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement.

The Examiner states:

"The specification as originally filed does not disclose or describe that the "first conformal barrier" liner has only vertical portions "of a constant thickness" on the sidewalls of the opening. As shown in figure 2, the first conformal barrier liner 126 does not have a constant thickness at the vertical portions. It seems to the first conformal barrier is the barrier layer formed on the first dielectric layer, have a different thickness at the bottom corner. According to the specification which is the first channel dielectric layer (see pg. 6/lis. 17-32; pg. 7/lis. 1-29). The layers 146 cannot be recognized as to be the first conformal barrier layer since it is formed in the via dielectric layer and not in the first dielectric layer as specified in claims 7 and 14."

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Regarding claim 7, it is believed the explanation above regarding FIG. 2 explains why this claim is in compliance with 35 U.S.C. 112, first paragraph.

Claims 13, 18, 19 and 20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

"Claim 13 recites the limitation "the via dielectric layer, the second dielectric layer" in line 2. There is insufficient antecedent basis for this limitation in the claim."

Regarding claim 13, this claim has been amended to delete the aforementioned limitation and correct the remaining grammar.

"Claim 18 recites the limitation "the second conformal barrier liner" in line 2. There is insufficient antecedent basis for this limitation in the claim."

Regarding claim 18, this claim has been amended to delete the aforementioned limitation and correct the remaining grammar.

"Claim 19 recites the limitation "the second channel dielectric layer" in line 2. There is insufficient antecedent basis for this limitation in the claim."

Regarding claim 19, this claim has been amended to delete the aforementioned limitation, the limitation regarding the via dielectric layer for which there is also not an antecedent basis, and correct the remaining grammar.

"Claim 20 recites the limitation "the second conductor core" in line 2. There is insufficient antecedent basis for this limitation in the claim."

Regarding claim 20, this claim has been amended to delete the aforementioned limitation and correct the remaining grammar.

Based on the above, it is respectfully submitted that claims 13, 18, 19 and 20 are allowable under 35 U.S.C. 112, second paragraph, as being definite for particularly pointing out and distinctly claiming the subject matter which Applicants regard as the invention.

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Claim Rejections - 35 USC §103

Claims 7, 10-14 and 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pramanick et al. (US 6,239,021, hereinafter "Pramanick") in view of Harper et al. (US 6,300,236, hereinafter "Harper").

The Examiner states:

"Regarding claims 7 and 14, Pramanick (e.g. fig. 2 & claim 1) shows an integrated circuit comprising: a substrate 108 having a semiconductor device (e.g. fig. 1; col. 1/lls. 17-23 & col. 3/lls. 33-58); a device dielectric layer 110 over the substrate; a first channel stop layer 114 over the substrate and the device dielectric layer having a portion open to the semiconductor device; a first channel dielectric layer 116 over the first channel stop layer having a first channel opening provided therein having sidewalls in the first channel dielectric layer; a first conformal barrier liner 123 in the opening, acting as barrier to diffusion of conductor core material to the first channel dielectric layer; a treated area 124 on the first conformal barrier liner and the first channel stop layer to increase adhesion properties thereof; and a first conductor core 120 in the opening over the vertical portions of the first conformal barrier liner and the first channel stop layer, the first conductor core connected to the semiconductor device. Pramanick does not teach that the first conformal barrier liner has only vertical portions on the sidewalls of the first opening in the first channel dielectric layer. However, Harper (e.g. fig. 2b) teaches a first conformal barrier liner 15 having only vertical portions on the sidewalls of a first opening 14 in a first channel dielectric layer 11 b. According to Harper, this type of embodiment improves the device electromigration lifetime (col. 1/lls. 19-67; col. 2/lls. 1-62). It would have been obvious to one of ordinary skill in the art at the time the invention was made to make the first conformal barrier liner having only vertical portions on the sidewalls of a first opening in the first channel dielectric layer disclosed by Pramanick in accordance with Harper's invention in order to improve the electromigration life of the device."

Regarding claim 7, it is respectfully submitted that the amendments to claims 8 and 9 more clearly show that the allowable subject matter of claims 8 and 9 reside in claim 7.

Regarding claim 14, it is respectfully submitted that the amendments to claims 15 and 16 more clearly show that the allowable subject matter of claims 15 and 16 reside in claim 14.

Also regarding claims 7 and 14, as exemplified in claim 7, the claimed combination has been amended to include the following limitation not taught or suggested in either Pramanick or Harper of:

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"a first stop layer over the substrate having a stepped opening to the semiconductor device;"

Thus, claims 7 and 14 are allowable under 35 U.S.C. 103(a) as being patentable over Pramanick in view of Harper because:

"[T]he prior art reference (or references when combined) must teach or suggest all the claim limitations." [bold for clarity] *In re Vaeck*, 947 F2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991)

Regarding claims 10-13 and 17-20, these dependent claims respectively depend from independent claim 7 and 14, and are believed to be allowable since they contain all the limitations set forth in the independent claim from which they depend and claim additional unobvious combinations.

Other

The Examiner stated, the prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Bao et al (US 6,455,417, hereinafter "Bao"), Li et al (US 6,040,243, hereinafter "Li"), Lee et al (US 6,486,059, hereinafter "Lee"), and Nguyen et al (US 5,904,565, hereinafter "Nguyen") teach structures and procedures similar to the instant invention.

These other references cited by the Examiner showing the prior art have been considered and are not believed to disclose, teach, or suggest, either singularly or in combination, Applicants' invention as claimed

Conclusion

In view of the above, it is submitted that the claims are in condition for allowance and reconsideration of the rejections is respectfully requested. Allowance of claims 1-20 at an early date is solicited.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this

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paper, including any extension of time fees, to Deposit Account No. 01-0365 and please credit any excess fees to such deposit account.

Respectfully submitted,



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